two formidable objections which he foresaw would be brought against them, namely, the improbability of two bodies endowed with enormous energy in the form of rapid motion coming into actual collision with one another, and secondly, the want of experience of like movements in the universe. It is but seldom that a theory, however ingenious, can be upheld against *two* antecedent improbabilities, but granting Dr. Croll all he asks, even to the existence of non-luminous bodies moving through space with a velocity of 1,700 miles per second, there may still be brought more serious objections than either of the above. Our knowledge of the actual motions of the stars in space has recently been greatly extended, and it is now well known that proper motions exceeding thirty miles per second are very rare, and that probably there is no well-authenticated case of a velocity greater than forty miles per second. It has long since been ascertained also that the proper motion of our own sun in space is at the rate of four miles per second only. It is, of course, possible or fortunate that the two bodies from whose collision the solar nebula originally derived its vast stores of heat might be of such equal masses and velocities that the motion of translation should be so nearly destroyed, and the whole converted into heat, but it is inconceivable that amid all the diversity of dimensions of the heavenly bodies it should invariably happen that the resultant movement of the combined masses should be reduced to such insignificant figures as the above.

It is strange that it should not have occurred to Dr. Croll that the heat generated by the impact of two bodies in such rapid motion cannot be considered as remaining constant for nearly the length of time he computes, because the rate of radiation from so intensely heated a sun will be enormously greater than it is now. Indeed the origin of the solar heat does not materially affect the question at issue, which is rather of the means of continuous and equable supply than of the primary source. The contraction theory of Helmholtz addresses itself to meet this difficulty, but alone it is probably insufficient. In the *Popular Science Review* of January, 1875, I have directed attention to other possible and supplementary means of heat supply, which, being continuous, will tend to prolong the period during which the radiation of heat from the sun shall be nearly constant, and hence favourable to the development of organic life. Without advocating any peculiar views of my own which recent discoveries have necessarily somewhat modified, I content myself with pointing out what appear to me to be grave difficulties in the way of accepting the theories and explanations of Dr. Croll.

JOHN I. PLUMMER

Nacton, Ipswich

Faraday's "Experimental Researches"

DOUBTLESS many of your readers will have observed an advertisement of a well-known antiquarian bookseller professing to be able to supply "a perfect copy" of Faraday's "Experimental Researches" at a price not too exorbitant for a complete original copy of that priceless work.

Any who may have applied for the work will, perhaps, share with me the indignation with which they discover that the so-called *perfect copy* is only such in virtue of being a "facsimile reprint" (*sic*) not twelve months old, though dated on the title-page 1839. But perhaps scientific men are too innocent of the ways of antiquarian caterers to receive with calm contentment the assurance that they have not been deceived.

SILVANUS P. THOMPSON

University College, Bristol, February 5

CLAUDE BERNARD

IN rapid succession we are compelled to chronicle the recent serious losses by death to French science. To the names of Leverrier, Becquerel, and Regnault, we regret to add that of the equally famous physiologist, Prof. Claude Bernard, who died in Paris on the evening of February 11. He was born at St. Julien, near Villefranche, in the Rhône department, July 12, 1813. After completing a course of study in the Paris faculty of medicine he was appointed hospital-surgeon in 1839. Two years later he became assistant to the well-known physiologist, Prof. Magendie, in the Collége de France, and continued in close connection with him for thirteen years, during the last half of this time lecturing himself as *privat-docent*. A series of notable discoveries made during this period caused his election, in 1854, to the Academy of Sciences, and his appointment to the newly-founded professorship of general physiology in the Collége de France. This he exchanged in the following year for the chair of experimental physiology, a position which he occupied up to the time of his death.

As an original investigator, Bernard stands among the foremost of the century. He entered upon his career at the epoch when Magendie, the chief founder of the modern French school of physiology, had completely altered the character of this study by the introduction of a variety of experiments on living animals, such as the action of the alkaloids, &c. Bernard entered with enthusiasm on the new field of experimental activity opened up by his master, and by a swift succession of remarkable discoveries with regard to the changes taking place in the human organism, guided the young science into a completely new channel. Of these the most important were connected with the phenomena of digestion, and especially the relation of the nerves to these processes. Perhaps the most valuable was the exhaustive investigation into the functions of the pancreatic juice (in 1850), in which he showed that this fluid was the only one in the digestive apparatus capable of so modifying fatty matter that it can be absorbed by the chyle ducts, and that the digestion of this portion of the nourishment introduced into the system was its sole purpose in the animal economy. Another discovery at this period, which attracted universal attention, was that of the saccharine formation in the liver. Bernard found that not only was sugar a normal constituent of the liver, but that while the blood, on entering into this organ, was completely free from saccharine matter, large amounts of the latter could be detected after it left the liver to pursue its way to the heart. Interesting as this fact was, it was eclipsed by the discovery of the two remarkable connections between this function of the liver and the nervous system.

It was ascertained, first that this normal formation of sugar in the liver could be totally interrupted by severing the pneumo-gastric nerve in the neighbourhood of the heart; and secondly, that by wounding a certain place on the fourth ventricle of the brain, near the origin of the eighth pair of nerves, it was possible to cause such an abnormal formation of sugar that an animal within two hours after such an operation showed all the symptoms of diabetes. In recognition of these brilliant experiments the physiological prizes of the French Academy were bestowed upon Bernard in 1851 and 1853. In a continuation of this line of research in 1859 he made the important discovery that the sugar for the embryo is prepared in the placenta, and not in the liver. Shortly previous to this time he published the results of extensive observations on the temperature of the blood, in which he showed that remarkable alterations in the degree of warmth take place on the passage of the blood from one organ to another, especially in the different parts of the digestive and respiratory systems. The absorption of oxygen by the blood formed the subject of a memoir in 1858, from which it appears that the coefficient of absorption diminishes gradually with an increase of temperature, and becomes zero at 38°—40° C. in the case of mammals, and 40°—44° C. in the case of birds, viz., at the temperatures at which death sets in. The respective amounts of oxygen in the arterial blood, and red and black venous blood were likewise carefully estimated, and the chemical causes for the differences in colour revealed. Among the other leading researches of Bernard must be mentioned those on the comparative properties of the opium alkaloids; on the poisonous properties of curarine; on the sympathetic nerves in general; as well as numerous investigations on the individual processes in the act of digestion. Many of these discoveries, as well as the results deduced from them, have formed subjects for long-continued controversies. With rare exceptions, however, not only

Bernard's experimental correctness, but the soundness of his theoretical deductions, have been universally recognised by leading physiologists.

As an author Bernard was not so fertile as most of the scientists of the present day in France. The few works emanating from his pen are regarded as standard even outside the limits of his own country. This is especially true of his "Leçons de Physiologie Expérimentale Appliquée à la Médecine" (1865), a work valuable not only for the exceedingly thorough, systematic, scientific treatment of the subject, but also on account of the numerous indications for the application in medicine and surgery of the results gained by physiological research. His other works are "Leçons sur les Effets des Substances Toxiques et Médicamenteuses," 1857, "Introduction à l'Étude de la Médecine Expérimentale," 1865, and "Leçons de Pathologie Expérimentale," 1874.

As a lecturer Prof. Bernard was not only peculiarly successful in the professor's chair, but was also distinguished among the *savans* of Paris for his able and lucid presentation of scientific facts to general audiences. He was busily engaged in the fulfilment of his professorial duties when the short sudden disease preceding his death interrupted the courses of lectures, and put an end to a life of rich and varied scientific activity.

As a mark of the universal respect and honour in which he was held, the authorities of the French Republic have decided that his funeral shall be at the expense of the nation. T. H. N.

A PHYSICIAN'S EXPERIMENT

AT a public lecture at Salisbury Hall, Oxford Street, recently, Dr. T. L. Nichols, of Malvern, related particulars of a "Dietetic Experiment" upon himself, which he had made with a view to solving a difficulty as to the quantity of food per diem which would best sustain health. He had always been temperate, his only excess being to be overworked. He rose between five and six, and worked well through the day, but avoided night-work. He seldom knew pain, never took medicine, and had excellent health. He usually ate twice in the twenty-four hours, at nine and five, because, for him, long rest for the stomach was better than shorter intervals. He appeared to sleep better for not eating after four o'clock. Every one should sleep upon, at least a quiet stomach. He had carefully noted the "dry weight" of the food he had taken, oatmeal, &c., he counted as dry weight. The weight of water forming a large portion of all food had not been reckoned, because it did not supply nutrition. Eggs and milk were perfect foods, but were largely composed of water. Milk was the most perfect food, though not the best for adults. He began on November 5, his food being chiefly bread, fruit, milk, and vegetables. During the experiment he had taken no flesh meat, wine, beer, spirits, tea, coffee, or tobacco. With regard to smoking, if it were the good thing people said it was, why not encourage their wives and daughters to smoke? Medical authorities differed as to the quantity of food that should be eaten, and it was a common belief that the more food we ate the greater would be our strength.

The first week, the lecturer stated, he lived on bread, milk, fruit, and vegetables, the total weight being 3lb. $9\frac{1}{2}$oz, costing 3*s.* 1*d.*, *i.e.*, a daily average of $8\frac{3}{14}$oz., costing $5\frac{2}{7}$*d.*; this was slightly below his standard of 6*d.* a day. He felt better, and clearer, and brighter than usual. The second week he studied quality rather than cheapness, his food being Food of Health, milk and fruit. Total weight 4lb. $4\frac{1}{2}$oz., cost 3*s.* 8*d.*, average per diem $9\frac{5}{7}$oz., costing $6\frac{2}{7}$*d.*, and nothing could have been better, physiologically, than the effect of that food upon him. His digestion was simply perfect, and the action of the whole system as good as it could be. He then discontinued milk as unnecessary. For the third week the total amounted to 3 lbs. 2 oz. = 1*s.* 9*d.*, giving an average of $7\frac{1}{7}$ oz. of food costing only 3*d.* per day. Milk was not so cheap for food as Gloster, Dutch, and American cheese; because they had to pay for the water it contained. Doctors recommended 2 or 3 lbs. of food daily to repair the waste of the system; but he asserted that the waste of brain atoms and nerve force could not be measured. The food eaten had to be disposed of at great cost of life and strength, and he believed the wisest plan was to eat the smallest quantity that would properly support the body. The fourth week, his food being similar, weighed 3 lbs. 6 oz., costing 1*s.* $2\frac{1}{2}$*d.*, giving an average of 8 oz. = 2*d.* per day. He considered *8* oz. the *minimum* and *12* oz. the *maximum* quantity of food that should be taken per day. The total weight of his food during the four weeks was 14 lbs. 6 oz., costing 9*s.* $8\frac{1}{2}$*d.*, average per week 3 lbs. $9\frac{1}{2}$ oz.; per day $8\frac{1}{2}$ oz., costing per week 2*s.* 5*d.*, and per day $4\frac{1}{7}$*d.* He then added soups, puddings, eggs, &c., and the fifth week his food weighed 3 lbs. $12\frac{1}{2}$ oz., costing 3*s.* 4*d.*, being at the rate of $8\frac{4}{7}$ oz., a $5\frac{5}{7}$*d.* per day. For the sixth week the figures were 63 oz., at 2*s.* 1*d.*, or 9 oz. at $3\frac{4}{7}$*d.* per day. He had taken the diet without stimulants and had experienced a constant increase of health and strength and power to work, and his weight had remained at about 12 st. 2 lbs., except that at the end of the fourth week there had been a slight decrease which had since been recovered. The experiment had been fairly made upon an average subject and the results were satisfactory. He was convinced that they ought to give rest to the stomach, and that this would cure all cases of dyspepsia. The diet question was at the root of all diseases. Pure blood could only be made from pure food. Proper attention to diet would reduce the rate of infant mortality and remove many diseases. If the drink of a nation were pure and free from stimulating qualities and the food was also pure the result would be pure health.

SOCIAL ELECTRICAL NERVES

OUR modern Mercury since the year 1846, when the first system of electrical highways was laid down from the metropolis to Norwich, Southampton, Crewe, and Exeter, has not been idle. The wonderful development of the laws enunciated by Wheatstone which regulate the transmission of electric currents through solid conductors has resulted in some very remarkable inventions. At the date at which we write, from a crude beginning when with difficulty electric speech could be conveyed to such limited distances as Manchester and Norwich, we are now able to record the transmission of the Queen's speech to the confines of the empire in a few minutes.

Since the first introduction of private and social telegraphy in 1861, when Reuter first proposed to connect the Reporting Gallery of the House of Commons with the editor's room of each of the leading metropolitan newspapers, the electrical wire has become the means of reducing the cost of newspapers and of sending the news almost simultaneously over the country. Before that time the press paid large sums for "special correspondents," and papers were exceedingly jealous of each other's privileges.

Year by year the public have reaped additional advantages. Submarine telegraphy now includes within its grasp New Zealand, Japan, and the western shores of South America. The private wire system of alphabetical telegraphy between offices and works, carried out over the chief centres of the United Kingdom by Holmes in 1861–5, is in still further process of development. The express speed of the Wheatstone automatic system, duplex and quadruplex telegraphy, and the telephone of Bell, with its delicate electrical sound-wave indications, have all passed into practical existence and become the property of the civilised globe. Still, notwithstanding the advances indicated, much remains to be done.